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THE S I S
on
BACILLUS COLI INFECTION
of the
URINARY TRACT.
by
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April 1910.



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I N T R O D U C T I O N .

The purpose of this Thesis is to place on record some cases of Urinary Infection, due to the *E. Coli* and to supplement the observations by a review of the literature dealing with the Origin, Course and Treatment of the condition. Reblaud in 1892 was one of the first to draw attention to the subject in a paper on Pyelitis occurring during Pregnancy (41.) This was followed by several papers by other French writers and later by German and American medical men. It is only within the last few years that its importance has been recognised in this country and one has to search the pages of the Medical Journals to obtain adequate descriptions of the different forms the Infection may take.

Within the last five years a number of articles have appeared dealing with the subject, especially from the point of view of the obstetrician. Still the characters of the Infection are not sufficiently well known and it will only be when the General Practitioner who has the best chance of seeing the milder cases recognises the condition that/

that it will be understood how common it is. In an ordinary Country Practice, that of Dr. Dawson, Corbridge, within the space of eighteen months, five cases have been treated for symptoms of the Urinary system, referable to Infection by the B. Coli. From these cases it can be seen how easy it would be to overlook the nature of the illness, if the symptoms of the Infection had not been familiar. In many the symptoms are slight and tend to spontaneous cure or at least respond readily to treatment of the symptoms, or even merely to rest. Without a careful examination of the Urine a number of the cases would fail to be diagnosed, and one can readily recall cases with features similar to those here described, where the nature of the Infection had not been recognised. I believe that, if it were more frequently looked for, it would be found to be not infrequent in General Practice.

NOMENCLATURE.

The Title "Bacillus Coli Infection of the Urinary Tract" has been chosen as the title of this Thesis, as it seems to be the simplest and most correct to describe the subject we are dealing with.

B. Coli/

B. Coli Cystitis. B. Coli Pyelitis. Urosepticaemia etc., have been used by different authors to describe the condition. But in this paper we will take a broader view of the subject, so that none of these names will cover the ground of our investigation. The B. Coli has been discovered, as will be shown later, in the Urine of persons, who complained of no symptoms, referable to the Urinary system. Some cases show involvement of the lower positions of the tract only, while others have symptoms showing that the upper portion is the principal site of attack. Some writers have dealt with the condition as occurring in children, while others have restricted their papers to cases complicating Pregnancy and the Puerperium. Before proceeding further with the description of the condition I intend to give notes on the Five Cases that have occurred in this Practice, and point out the most important features in them. In all the cases recorded here the Infection was in the adult. In all, there was evidence of a lesion in one or more portion of the Urinary tract. In three the Infection arose in the course of Pregnancy. We have then a selection from which we can draw a clinical picture of the condition. A large number/

number of cases are found in the Literature and so we have plenty material for describing the disease as it occurs, both in its milder and more severe forms, in children and in adults.

CASE I.

MRS. F. Aet. 28. Primip. Preg. V months.

Patient's previous health was good. A year before the attack she had suffered from Cystitis with Haematuria, accounted for by exposure to cold. This attack was of short duration and passed off with ordinary treatment. There was no return of bladder symptoms till the date of this attack. She had not been constipated and was in her ordinary health

On Friday, 5th Feb. 1909, she was in town for some hours and had no opportunity to pass water but had no discomfort that night. Next morning she had frequent desire to micturate, with great pain and discomfort during the act, not scalding, but short stabbing pain at the Urethra. This continued till the Wednesday. During this time there was Albumin and Pus in the Urine, but no blood. On the Thursday the condition cleared up and she was able to go out in the evening. Next day she felt quite well with no frequency of micturition. On Saturday the 13th. she felt very miserable. At first she had no pain in the abdomen, but had headache, malaise/

malaise and frequency of micturition. In the evening she was seized with acute pain above the Right Iliac Crest, shooting down towards the groin. Next morning there was great pain and tenderness on the right side and in the Right Costo-Vertebral angle. There was also Haematuria. At first the Urine was coffee coloured, later bright red, but contained no clots. There was a considerable quantity of Albumin. The Microscope showed Red Blood Corpuscles, Leucocytes. Bladder cells, alone and in shreds, but no crystals and no Casts. This Haemorrhage, which was apparently from the bladder, was at its maximum on the Monday and gradually decreased till it disappeared on the Tuesday. On that day, the tenth from the first symptoms of illness, the pain was greater with two acute attacks shooting down from the back to the groin. The spasms lasted rather more than half an hour with two hours between the attacks. The Right Kidney region was swollen rigid and tender to the touch. The Bacteriological report was: Pure Culture of B. Coli. It was determined before trying a vaccine, /

vaccine, to give large doses of alkaline medicines with Calomel. Very quickly the temperature came down from 101⁰F to below normal and remained so. On the 19th. there was extreme constipation and the bowels were greatly distended. An enema gave good result. The pain on the right side had greatly diminished but on the 19th. there was an acute attack on the left side. It lasted for two or three days and was not so severe as it had been on the right. It gradually passed off leaving a feeling of weakness on both sides.

The Urine was crowded with pus and remained so till 1st. March when there was an improvement and a decrease in the frequency of micturition. The patient was allowed up on 4th. March, but this increased the amount of pus, so for a week she had little liberty. She was allowed downstairs on the 14th. by which time the quantity of pus had greatly diminished. Salol was tried instead of Calomel, which had a very exhausting effect. Treatment was continued during the remainder of Pregnancy. Patient went on to full term and gave birth to a live and healthy child. Parturition and Puerperium were/

were normal. Patient is in good health now, a year after the attack.

POINTS IN HISTORY. There was a previous attack of Cystitis. The present attack began with Cystitis, which helped to an early diagnosis. There was no history of constipation or Intestinal disorder. The Kidney substance was not affected. It was a case of Cystitis. Ureteritis and Pyelitis. At first the Infection was unilateral and the left side was attacked after the right side and when the acute stage in the right had passed off. There was in this case some paresis of the bowel. The patient responded well to the treatment by alkaline medicines. The Pregnancy was not interrupted and the patient has subsequently enjoyed good health.

CASE/

CASE II.

MRS. B. Aet. 40. Primip. Preg. IV month.

Previous health was good and patient was a strong healthy woman. She had been married 6 months. On 5th. March 1909, she first complained of "lumbago" pains, the pain extending the whole length of the spine and was also present in the flanks, especially on the right side. She felt very cold in the lower part of the back. On the 11th. she was sick and next day the pain in the back was much worse so that she could not straighten herself. She was first seen on this day. Her temperature then was 100.6 °F. Pulse 86. She was in her fourth month of Pregnancy. The abdomen was flaccid. There was pain and tenderness in both Costo-Vertebral angles, extending over the Iliac Crests and down to the groin. The pain was greater on the Right side and especially at McBurney's point. The bowels were very constipated. There was great frequency of micturition, with scalding pain at the end of the act.

On the 13th. the bowels were moved and on the next day the abdomen was much distended. The Urine contained a large quantity of pus.

On the 13th. the frequency of micturition/

micturition increased, pain was more severe and in the afternoon the patient had a rigor with spasms of pain on the right side.

The acute pain passed off and left a dull aching pain in the back and pain over the front of the abdomen. She had a short cough and pain on taking a long breath although the chest was quite clear. There was blood in the urine. The Bacteriological report received, was: Pure Culture of B. Coli. The Treatment was large doses of Pot. Acetate and Pot. Citrate. This was persevered with, but without any improvement. The patient continued to have a swinging temperature, varying from 98.4° to about 102° each day. There was great pain and hyperaesthesia of the skin on the right side and also over the sacrum. There was a great quantity of pus in the urine. The blood showed a Leucocytosis of 18,000, with a marked increase of Polymorphs.

The symptoms increased about the 23rd. The patient had a facies of typical toxic abdominal type. She had frequent sweatings and bad constant headache. There were many granular/

Notes of Case.

Name { Mrs B.

Age 40.

Diet

Case Book No. 1

Chas. I.

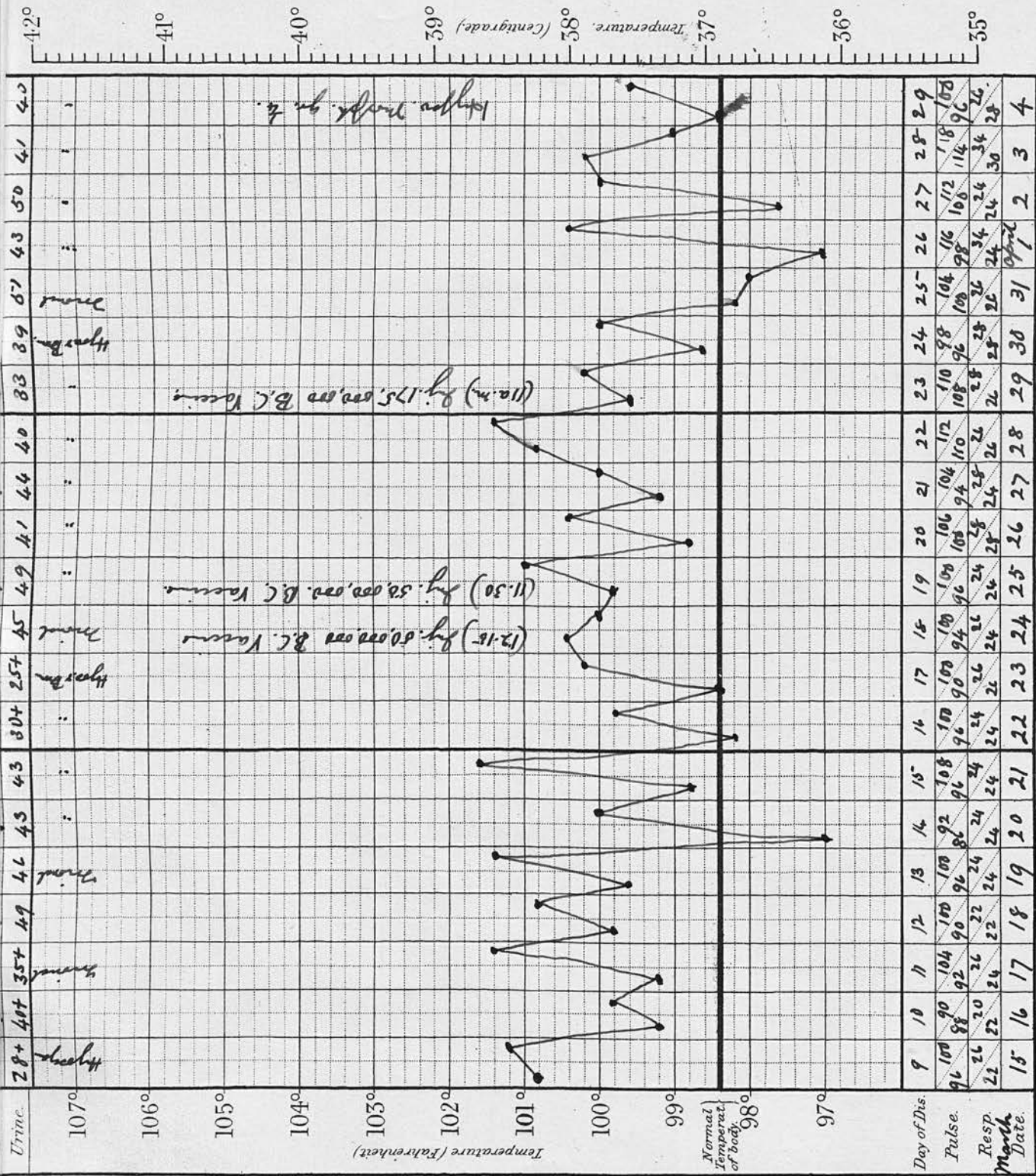
Date of admission.

Result

Entered at Stationer's Hall.

Printed and Published by Woollerspoon & Co. 6, Gate Street, Lincoln's Inn

Gould's Clinical Chart



Notes of Case.

Name Mrs. B.

Age 40.

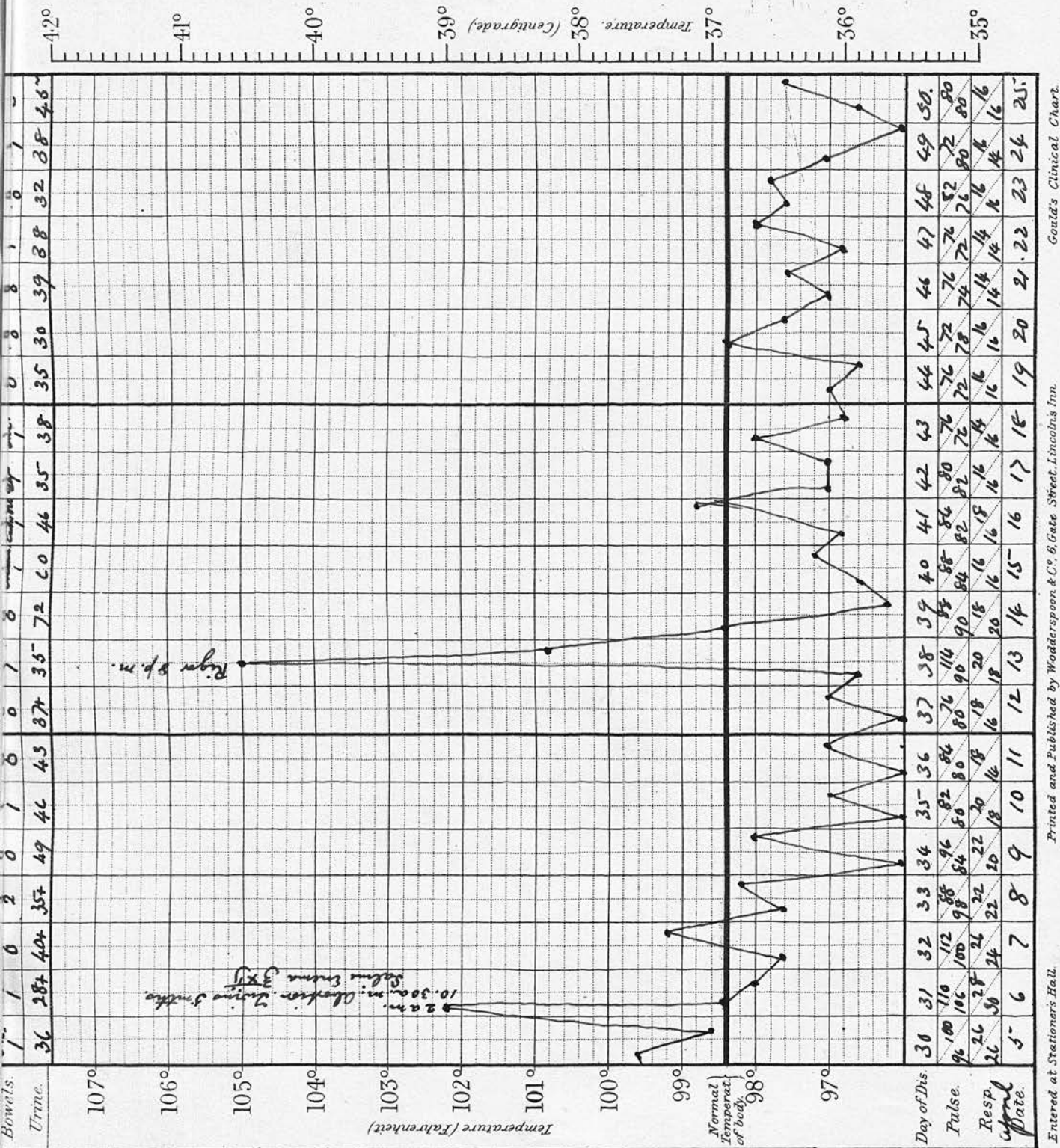
Diet

Case Book No.

Chart II.

Date of admission.

Result



granular casts, but less pus in the Urine. The Heart was very dilated.

A Vaccine had been prepared and 50,000,000 were injected. In three quarters of an hour the relief was marvellous and the patient had a good evening and night. Next morning, however, the symptoms returned in all their severity. Another injection of 50,000,000 was given but produced no effect. The patient was now very exhausted. On the 29th. 175,000,000 Vaccine was given, again without any effect either one way or the other. The induction of abortion was considered, but the surgeon consulted held that the risks of sepsis in this case were so great as to contraindicate such a measure. He advised Nephrotomy or Nephrectomy and arrangements were made for the operation. Before it could be undertaken the patient aborted and was delivered on 5th April, the 31st. day of the illness, of twins. She was extremely collapsed but the pain in the Right Costo-Vertebral angle and in the right flank disappeared and she was free from pain till the evening, when there was slight abdominal discomfort and rise of temperature.

The Urine contained fewer casts and less/

less pus. but a large number of Uric Acid crystals. After the abortion the patient gradually improved the pain was much less and the right Kidney could be felt distinctly enlarged.

A week after the abortion, the Temperature rose to 105° F. and the pulse was 138. The pain returned also. It was discovered that the patient had refused to take the Alkalies for two or three days. These were pressed again, with immediate improvement and no further relapse.

The Alkalies were continued for two months. The patient has had no further attack of pain or illness and at the present date a year since her abortion, is in good health.

POINTS IN THE HISTORY. In this case there was no History of Cystitis, but there was very obstinate and marked constipation. Like case I it was a complication of Pregnancy. The simpler treatment did not have any effect and patient was very seriously ill. The Renal Parenchyma was affected, as shown by the presence of a great abundance of Casts. In this case a Vaccine was tried. The beneficial result of the/

the first injection followed too soon to be causally connected, and in this case the Vaccine did not have any effect.

Abortion was followed by such a marvellous improvement, that there can be no doubt that it saved her life. In the future with a similar case I should have no hesitation in advising the induction of Abortion where the condition did not yield to simpler treatment and the patient was losing ground.

The other point of note is the relapse that patient had, apparently due to the stopping of the alkalies.

CASE/

CASE III.

MRS. E. Aet. 32. Nullipara. Married 2 months

Patient was a healthy woman. She was not pregnant. Before her illness she had been troubled with obstinate constipation.

On Tuesday 2nd. September 1908 she complained of frequency of micturition, pain during the act and tenderness in the Hypogastrium. This was her condition when first seen. Five days previously she had a chill during her period. Her temperature was normal and her pulse 76. The cystitis lasted for two days. There was pus in the Urine, which was acid and had no ammonia-cal smell. She refused to go to bed on Saturday there was blood in the Urine and pain in the right side, but no rigidity. Pulse was 100 and Temperature 100.4° . She was treated with Calomel Salol and Uretropin and although the pain continued the Temperature came down to normal. On Wednesday the Pulse was 118 and the temperature 101.5° . There was great tenderness and rigidity in the Right Costo-Vertebral angle and in the right flank. The kidney was enlarged and easily palpable. The patient was very prostrate. A pint/

pint of saline per rectum was given and her condition improved. The pain was less although she still had rigidity of the abdominal muscle on the right side and the frequency of micturition still continued. During the next week the pain lessened, the frequency of micturition passed off and the rigidity disappeared. There was no pus in the Urine after three weeks. The Kidney was found to be freely movable. There has been no recurrence and patient has since been in good health.

POINTS IN THE HISTORY This was a case where there were no casts and probably no involvement of the Renal Parenchyma. Unlike the two previous cases it did not occur during pregnancy. With regard to causation the extreme constipation and the mobility of the kidney are worthy of note. The patient was extremely ill, but made a complete recovery. In this case Urotropin was tried along with Intestinal Antiseptics and treatment of the constipation. This is an example of B. Coli producing Pyelitis with a preliminary Cystitis.

CASE IV.

MRS. T.

Aet. 91.

Patient was an old lady, who had enjoyed previously splendid health.

In May 1908 as the result of a fall she sustained a Fracture Dislocation of the Spine in the Upper Dorsal region. The lower limbs and Abdomen were completely paralysed and the upper limbs and chest partially. She slowly recovered some power, both in the upper and the lower limbs and is still alive, nearly two years after her accident. She has had several attacks of Acute Bronchitis, from which she recovered. From almost the beginning she has had pyuria, with no pain over the bladder. The catheter was passed once a day and the bladder washed out. One or two ounces of Residual Urine was always found and it was always Alkaline and Ammoniacal.

Last November the patient refused to allow the catheter to be passed for several days. As this time she was in fair health, her temperature never being above normal, although her Urine was very ammoniacal. Following the refusal to allow the catheter to be passed, her temperature rose on the fifth day to 100° and on the/

the eighth to 102°C. Her urine was then found to be very acid and Bacteriological examination showed that there was a pure culture of B. Coli. The Urine contained a great quantity of pus and had a distinctly "Fishy" odour. Her bowels were obstinately constipated and she looked and felt ill. Urotropin was given and her bowels were moved. Three days after the Urotropin was commenced and the seventh of the fever, her condition improved and the temperature came down below normal and rose only once above it. Gradually her appetite came back and she returned to her former state of health. Urotropin has been continued since and the Urine has remained Acid. There is still a considerable quantity of pus and three months after the attack the Bacteriological report was: Pure Culture of B. Coli.

POINTS IN HISTORY The history of this case apart from the B. Coli Cystitis is remarkable, when one considers the serious nature of the injury in an old lady of 90. It is an example of B. Coli Cystitis, replacing a mixed Infection. Urotropin in this case seems to have/

have been beneficial. Although the acute stage passed off quickly, the B. Coli was found in pure culture three months after. The acid state of the Urine seems to have been inimical to the growth of other organisms.

CASE/

CASE V.

MISS W. Aet. 20. Primip. Preg. 3 months.

The patient was a healthy young woman, who came complaining of pain on making water. Her last period had been three months previously and she admitted the possibility of Pregnancy. Her breasts were swollen and she had had "morning sickness".

A few days before seeking advice she had great pain on making water, so much so that she was afraid to try to do it. There was no great frequency during the day but she had to get up twice every night. She then had pain in the back, shooting round to the front, down into the groin. Her bowels had been very constipated. Her temperature and Pulse were normal and she had not taken to bed. Her Urine was acid S.G. 1020. There was a flocculent deposit, which showed pus cells microscopically. Bacteriological examination gave a Pure culture of B. Coli. As the symptoms were not urgent it was thought advisable to do as little as possible in the way of treatment by drugs, the patient being unmarried. She was advised to keep her bowels regular to take simple diet and to/

to rest and to report if she grew worse. This simple treatment improved the urgent symptoms and a month later she felt better, the pains having disappeared. The urine still contained pus and she is under observation still. This is of special interest as a slight case that might have been overlooked, if we had not been warned by previous experience to be on the outlook for B. Coli Infection.

CLASSIFICATION/

CLASSIFICATION.

Before proceeding further we may make some preliminary remarks which will pave the way for the rest of the paper. The B. Coli is a normal inhabitant of the Intestine and is probably essential to digestion in the Colon. Under some circumstances it assumes pathogenic properties and manifests wide variations in virulence. The same variations are found in Infections of the Urinary system, from Bacilluria in healthy persons, to a very malignant form, which may be fatal in a very short time.

Briscoe (7) protests against the differentiation of Bacilluria as a separate entity. He considers that in all cases the organism gains access by the descending route and that Bacilluria ought to be regarded as only a phase, in which separate stages of varying degrees of severity may be recognised. If his view of the origin of the Infection be correct, then this would be the best standard for Classification. The question of Aetiology is still however a matter of controversy and will be discussed later on. Meanwhile we will consider the features of the different forms of infection/

infection and take them up regionally. We shall consider Bacilluria first taking it to include as most writers do, those conditions, in which the B. Coli is found in the Urine without producing symptoms, which can localise a lesion in any part of the Urinary tract. That there is a lesion, of course, can not be denied.

The B. Coli can be found in many Urines, where its presence may be accidental. It may occur also in mixed infections, where it is secondary to some other organism. But the cases to which we refer are those, where the B. Coli has been found in pure Culture in catheter specimens or at least uncontaminated specimens of Urine, and are the important factor in the disease.

It is difficult in many cases to localise the exact site of the Infection and in many it is progressive, passing from one portion of the tract to another. Nevertheless we can arrange the cases into classes, which are fairly definite. These accordingly to the order we will consider them are:-

- (1) Bacilluria
- (2) Urethritis
- (3) Cystitis
- (4) Infection of Upper Portion of tract including Ureteritis. Pyelitis. Nephrosis and Renal abscesses.

I, BACILLURIA/

1. BACILLURIA.

As has already been mentioned the B. Coli has been found, by many observers, in Urine, where the patients complained of no urinary symptoms.

Dudgeon (12) examined the Urine in a number of different cases. Constipation is a common symptom in B. Coli infections. In an examination of the Urine of 20 cases of marked Chronic Constipation, he found the B. Coli in two. In both cases there was pus, but no symptoms and its presence was unsuspected.

In 20 cases of appendicitis the B. Coli was found in 4. In two of these the Urine was clear and in the other two cloudy due to Bacilluria. In 3 out of the 4 there was suppuration round the Appendix. The B. Coli is not necessarily present in the Urine in cases of diffuse Peritonitis.

In Pregnant women it was present in 9 out of 45 Urines examined, where there were no Urinary symptoms. In only one of these was there pus.

At the Evelina Hospital for children during six months the B. Coli was found in 6 cases out of 145. In 2 of these there were no symptoms in 2 febricula/

febricula and in the other two the cases were more severe.

In children B. Coli is found commonly in the urine in Diarrhoeal diseases, in children with thread-worms and in obstinate cases of Incontinence of Urine.(3) In these cases the Urine is Acid. There is a trace of Albumin and a few pus cells and many B. Coli. The urine is described as having a "Fishy smell". A History of Suprapubic or Subcostal pain is rarely elicited. The patients are shy, nervous, stupid or sullen. They suffer from headaches. The tongue is coated. The bowels are irregular but there is rarely "coprostasis".

Briscoe (7) says the only symptoms in this case are constipation occasional headache, slackness and malaise. He gives an illustration of a girl aged 14, with these symptoms, who is a typical case of Postural Albuminuria. The B. Coli are found only during the attacks, and under treatment against the B. Coli the patient's condition is improving.

Prof. Hutchens of Newcastle describes similar cases. which he believes to be due to B. Coli septicaemia. One case, which confirms this, is that of a man, who was suffering from Cystitis of unknown cause, which ran a prolonged course without any/

any signs of improvement B. Coli was discovered in the Urine. The patient had suffered from a slight attack of Colitis two years before. By washing out the Colon the Cystitis very quickly cleared up. He has also found B. Coli in a number of obscure diseases and in some cases of neurasthenia. These have all been cured by Vaccines or by treatment directed against the B. Coli.

From these examples it will be seen that a more careful examination of the Urine may reveal the B. Coli in a number of cases, where its presence is not suspected. The routine examination of Urine is frequently very imperfect and if Albumin and Pus are not detected, the examination is not proceeded with further and so useful information is lost. Urine which is cloudy after filtering, probably contains organisms and should be examined microscopically. Dudgeon (11) lays stress on the importance of Cultural examination of Urine as in many of his cases the urine was quite clear. In obscure diseases and where the B. Coli is suspected a Cultural examination should be made.

Howard Kelly (17) considers that Cystitis would be discovered more frequently, if cultures were/

were habitually taken whenever the patient complains of even the slightest dysuria.

The presence of B. Coli in apparently normal urine shows how Infection of the Urinary tract may occur.

URETHRITIS/

(2) URETHRITIS.

Playm and Laag (28) have described a case of Acute Urethritis, simulating Gonorrhoea, which they considered due to B. Coli. An Acute Infection of the Urethra by the B. Coli must be very rare and I have seen no other case in the Literature.

In cases of Chronic Urethritis however, it is different and Dudgeon (11) states that in several of these, with discharge of pus cells and Bacilli, he has found a pure culture of B. Coli and no evidence of Gonococcus. He suggests that the so-called "Gouty Urethritis" may be due to an infection of the Urine and Urethral mucous membrane by the B. Coli.

These cases are not very common but they serve to show how patients may develop acute or subacute infection of the Urinary tract without any apparent cause. For those who hold the view of the ascending origin of the Infection it is of interest to show that the focus of inflammation may in some cases be situated in the urethra.

CYSTITIS/

(3) CYSTITIS.

Whatever the predisposing cause of Cystitis be, the determining cause is bacterial infection. In nearly half the cases, in which observations have been made, the B. Coli is found, but most commonly along with the Urobacillus and Staphylococci (38). In many cases the Cystitis is the precursor of Pyelitis as in three of the Histories recorded in this paper. Case IV is an interesting case of a B. Coli Cystitis in a Paralysed Bladder, previously the seat of a mixed infection. On two occasions the Bacteriological examination showed a Pure culture of B. Coli.

In most cases of Cystitis there is some retention of Urine and the constant stagnation affords a suitable medium for the growth of organisms. Congestion of the mucous membrane and the presence of a foreign body also predispose. A most important factor is the retention in Urethral stricture and in Prostatic enlargement. In 14 cases of Prostatic enlargement Wallace and Dudgeon (39) cultivated the B. Coli in 5, in 2 of which there was no pus.

In children Cystitis, more or less acute
is/

is not uncommon and according to Box (3) is more frequent than pyelitis. Those due to a pure culture of B. Coli are more common than those from mixed infection (37). It is especially common in little girls and is often a complication of Gastro Intestinal disease. The onset is sudden, sometimes after exposure to cold, sometimes after a slight injury to the perinaeum, (3) frequently no cause is assigned. There is painful and frequent micturition, screaming during the act and nocturnal incontinence. The temperature rises to 100° or 101° F. There is tenderness in the Hypogastrium, in the front of the thighs and in the perinaeum. Frequently there is blood in the urine, giving it a smoky appearance. Pus is also present. The stream is sometimes stopped by pain, but not so abruptly as when due to a stone. Milder attacks occur, in which there is no fever and the pain and tenderness are very slight. In these cases the chief feature is the increased frequency of micturition.

With regard to the site of pain in affections of the Bladder (23) it is interesting to note that the bladder is derived from two sources, the upper division from the allantois and the fundus from the cloaca. The nerve supply is also from two sources, /

9 X

sources, from the upper lumbar region and from the 2nd. and 3rd. Sacral. As a result the sensory symptoms are felt in two regions, the hypogastric, where the upper lumbar nerves are distributed and in the perinaeum and penis, where the sacral nerves are distributed.

The character of the Urine will be considered in the next class that of infection of the upper portion of the tract.

INFECTION/

(4) INFECTION OF THE UPPER PORTION OF URINARY TRACT.

By infection of the Upper Tract we mean those cases where the infection involves the Ureter, the Pelvis of the Kidney, or the Kidney substance itself. Frequently more than one of these is affected in the same case and occasionally all three. If the Infection progresses without alleviation, it spreads from the one to the other. This is the most serious type and it is this variety which figures most largely in recent literature. It is difficult if not impossible to tell exactly from the clinical picture, what the pathological condition is, unless an operation has been undertaken. Cases (15) have been recorded, where recovery has taken place in patients, on whom nephrotomy has been performed and in whose kidney haemorrhagic abscesses have been found at the operation.

With so much uncertainty as to the pathological condition, it is better to classify the cases according to the severity of the symptoms and the course of the disease. We will therefore divide this class into:

- (a) Acute Cases
- (b) Chronic Cases.
- (c) Mild Cases.

I. ACUTE CASES.

Acute cases of Pyelitis occur in small children and also in adults. As the conditions vary in causation in the course of the disease, and in the treatment, we may take them separately.

(1) IN CHILDREN.

In many cases the symptoms are slight and are little removed from those we have already mentioned when discussing Bacilluria. In a well-marked case the onset is sudden. The temperature runs up to 103° , 104° or higher. Generally the chart shows marked daily fluctuations. Thomson (37) lays stress on the occurrence of rigors in this condition, especially in girls, a symptom rarely seen in children. At the commencement there may be some suppression of urine but later the quantity may be increased to twice or thrice the normal. If protracted, the child becomes emaciated, has pronounced sweatings and enlarged spleen. Restlessness and obvious misery are characteristic and are important features to notice in infants, who are unable to complain of symptoms. It is most common in little girls and especially/

especially during the first two years of life. This condition should be borne in mind in children who have sudden rise of temperature. If Pyelitis is not thought of and the urine not examined, it may be the cause of much alarm. Rotch (32) considers the excretion of Uric acid by the Kidney or pelvic calculi important factors. The Urine is Acid. At the commencement there are no pus cells discoverable, but later they are numerable and clumps of Bacilli are found. Cultures generally give a pure growth of B. Coli. Rotch says that the "caudate cell", a small cell about the size of a renal cell, having a single nucleus and a tail is diagnostic of pyelitis. But practically this is not of much importance, for bladder cells undergo such changes in urine that they cannot be differentiated from those of the renal pelvis. The amount of albumin is small and a certain amount of nucleo proteid may be demonstrated. The urine is frequently turbid with bacilli and sometimes has a foul odour. In very acute cases there may be a few red blood corpuscles. If there are many tube casts, it is an indication that the renal parenchyma is involved.

Some cases have also symptoms of Cystitis and in some there is slight vulvitis. In boys it has/

has been recorded after circumcision (25). There is usually a history of constipation. Sometimes there is a previous Gastro-Intestinal disturbance and often an anal fissure or excoriation. Diagnosis may be assisted by the aid of the Cystoscope. Thomson (37) says that the children are sometimes drowsy and delirious, in which case their eyes often deviate. On this account cerebral mischief is apt to be suspected.

(II) IN/

(II) IN ADULTS.

In a clinical picture, it is important to emphasise the greater frequency of the Infection in women and the important association of the condition with Pregnancy. The occurrence in Primi para is common. In all three cases recorded here, this was so. But it is not uncommon in Multipara, some of whom have previously had one or more normal confinements, with no Urinary symptoms. In most cases the women have enjoyed good health. Ward (40) has found over 180 cases of B. Coli Infection complicating Pregnancy, recorded in the literature. In about half the cases he found the age to be between 23 and 28. It occurs at any time during pregnancy, but the greatest number he found to be at the 5th month.

SYMPTOMS. The onset is acute. The temperature rises suddenly. Often there is a rigor. Sometimes there is a preliminary cystitis with scalding pain at the Urethra, frequency of micturition pain over the Pubis and rarely haematuria. Later there is pain in the back and the patient may be gravely ill. The Temperature rises to 102° or as high as 105° . There are usually marked remissions each day. The Pulse is rapid. In one case (16) it was/

was 168 during a rigor. There seems to be considerable variations however both in Pulse and Temperature and Ward says that on the examination of a large number of cases there is no typical chart. The resemblance shown in a few cases is merely a coincidence, which is not borne out when a large number of cases are investigated. The temperature may fall by lysis or by crisis.

The bowels are usually very constipated but occasionally there is diarrhoea. The tongue is thickly coated. There is loss of appetite and great thirst. Usually severe headache and depression are noticed. Rolleston (31) points out that this amounts even to mental perturbation and the patient's memory of what took place may be very vague. This was the case in Mrs. B. recorded before. There is frequently meteorism, often from the beginning, but usually after some days.

The Pain is sometimes present before the
(23)
rise of Temperature. Dr. James Mackenzie has shown that it is incorrect to speak of Pain in the Kidney or along the line of the Ureter. The Kidney is insensitive to pain. What is felt is a Viscero-Sensory Reflex. That is, it is muscular and cutaneous hyperalgesia, due to reflex stimulation from the affected area. If the stimulus sent along the/

the sympathetic nerve be great, there is an overflow to neighbouring areas in the spinal cord and so a wider region of superficial pain. Similarly the rigidity or muscular contraction is a Viscero-Motor Reflex. In the case of irritation of the Ureter and Pelvis of the Kidney the Spinal nerve reflexly stimulated are from the 11th Thoracic to the 2nd. Lumbar. The pain is at first widespread, being referred to the whole Lumbar region and Iliac fossa of the side affected. Soon the patient localises the pain as starting in the back and passing in spasms downwards and forwards to the front and into the groin. If the stimulus be sufficiently strong there is persistent hyperalgesia of the skin and of the underlying muscles, as evidenced by deeper pressure. There will then be persistent contraction of the abdominal muscles on that side, producing marked rigidity.

Tenderness in the Costo-Vertebral angle of the affected side has been noted by most observers and is constantly present. The patient also frequently refers great pain to McBurney's point, a symptom, which may mislead the physician into thinking it a case of Appendicitis.

The Infection is most commonly Unilateral and the Right side is affected much more frequently. Sometimes/

Sometimes the Left side is also affected in a much milder degree. Very often, as in Case I. it is attacked later than on the Right side and when the acute stage on the right side is passing off.

Wright (42) describes a case where "the inflammation kept subsiding on one side and reappearing on the other".

The Kidney is usually enlarged and easily detected on Palpation, but the whole area may be too tender to allow of manipulation. The Ureter may be thickened and dilated and this may be found on Vaginal examination.

THE URINE. Dysuria and frequency of micturition are commonly complained of. This is often the earliest symptom. At first the Urine may be dark coloured but later it is light yellow and turbid with a flocculent deposit of mucus and pus. The B. Coli may be cultivated from a perfectly clear urine and in the condition of Bacilluria the Urine is turbid with bacilli and does not clear on filtering. In this case there is no pus and at most only a few leucocytes. Haematuria may be present, but not commonly.

The Urine has a "Fishy" odour said to be due to the formation of Methylamin (5). This is, however, /

however, not always noticeable. It is never ammoniacal in a pure B. Coli Infection, as the B. Coli has not the power of splitting Urea. The reaction is usually Acid. In this respect it differs from the urine in infections by other organisms. An acid Urine containing pus, should always make one suspect the presence of the B. Coli. The Acid reaction often makes one overlook the presence of slight quantities of pus or Bacilluria, since we associate Cystitis with an Alkaline and Ammoniacal Urine.

In ordinary culture media (26) the B. Coli has the power of forming Acid due to the fermentation of sugars in the media. Péré found however, that in peptone media, although there was an initial slight acid formation, at the end of four days it was Alkaline. Where the Urine has been retained the reaction may become Alkaline. Pilcher (27) found that, in some cases where he had catheterised the Pelvis of the Kidney, the reaction was Alkaline. In these cases there had been probably some retention of urine in the Pelvis of the Kidney. This does not happen often in the bladder, where the Urine is frequently being removed and so the media of the organism has not time to change to an Alkaline reaction. The B. Coli grows best in Alkaline or neutral/

neutral media, but grows readily also in Acid Urine. Most of the other organism found in the Urine can not grow in Acid media and hence we find that sometimes in a mixed Infection, if the Urine become Acid the other organisms disappear and a pure culture of B. Coli is found. This is what happened in Case IV. where the B. Coli was found in pure Culture in a formerly ammoniacal Urine.

On the other hand if Urine, which has been passed by a patient suffering from B. Coli Cystitis be taken, Wright found that organisms grew more readily in it than in normal Urine. In this case the reaction of the Urine will probably be changed and the conditions resemble rather those of the Urine retained in the Pelvis of the Kidney. Wright (1) thinks that normal Urine contains some factor inimical to the growth of micro-organisms, this factor belonging to the class of opsonins. The conclusion is, that the absence of that factor paves the way for the B. Coli Cystitis, or that the presence of the organism has altered the condition of the Urine in which it grows.

A nucleo Proteid is present in most cases (11). Albumin is almost always present. In severe cases it is present in considerable quantities. There/

There is no sugar or Bile. Where Urotrophine has been given there is sometimes a reducing substance.

MICROSCOPICALLY. Epithelial cells of various shapes are seen. Formerly some reliance was put on the shape of the cell and the "caudate" cell was considered pathognomonic of Pyelitis. As already mentioned this is not considered of importance now, as altered bladder cells are very difficult to distinguish from the cells of the Pelvis of the Kidney. Leucocytes and numerous Bacilli, mostly extracellular are also seen. In fresh Urine the bacilli are mobile and in stained films show beading as a rule and also clumping. Epithelial casts will be found in abundance, where the renal parenchyma is involved.

HAEMOPOIETIC SYSTEM. The Red Blood Corpuscles show the changes of a secondary Anaemia. There is always a marked Leucocytosis, the Polymorphs especially being increased. The blood examination is similar to that found in many other suppurative conditions and would not help one to differentiate it from Appendicitis. Occasionally the spleen can be felt to be enlarged.

OTHER SYSTEMS. Emphasis has already been laid on the frequency of Gastro Intestinal disturbance and constipation./

constipation. When the patient is very ill the heart may be dilated as in one of the cases recorded above. In the same patient there was a dry cough and there is frequently absence of Vesicular breathing at the neighbouring base of the Lung. The extreme depression and loss of memory have already been mentioned. Sleeplessness is very common requiring the use of Hypnotics. Wright (42) describes a slight attack of aphasia, lasting two days in one of his cases, which he considers Uraemic. Uraemic symptoms however are quite exceptional.

THE COURSE is extremely variable. There is a tendency to spontaneous cure and in the majority of cases the acute stage lasts only a week to a fortnight, although pus may be discovered in the Urine many weeks after the attack. In cases complicated with pregnancy if the condition of the patient becomes very serious, she may abort. This is followed by a marvellous alleviation of all the symptoms and a rapid recovery of the mother. If abortion does not take place and the case is not relieved by treatment the kidney substance will be ultimately involved. The patient then suffers from a severe septicaemia, which will be fatal.

II. CHRONIC/

II. CHRONIC CASES.

These are found only in adults and their onset is insidious, and the diagnosis often difficult. The acute stage in most of these is probably slight and so overlooked. The clinical features which mark the condition are malaise, muscular pains and irregular temperature. There are headaches and the patient feels fatigued. Bladder symptoms are slight or absent. There is always some pain and tenderness in the flank, although not nearly so severe as in Acute cases. The urine of such a case should be carefully examined. Albumin, Pus and Bacilli will probably be found and in suggestive cases a culture should be made from the Urine.

Under this class will come some of Prof. Hutchen's cases, where the diagnosis of Neurasthenia or Hysteria had been made. The importance of making a careful Urinary Examination is shown by the fact that he has had remarkable results from treating the B. Coli infection.

In Pregnant women the symptoms may lead to the diagnosis of "Pregnancy Kidney" or to make one suspect they are dealing with the Pre-eclamptic state.

In/

In cases which are very protracted careful examination should be made for Tubercle Bacilli, whose presence may be masked by the more easily found B. Coli.

III. MILD CASES.

Mild Cases probably occur far more often than can be estimated. They may not come under a physician or, if they do so, may be considered as trivial complaints. They are by no means rare in pregnancy. An example of this class is given in Case V, where the patient did not feel sufficiently ill to be up during any part of her illness. Frequency of Micturition especially in a pregnant woman should lead the medical man to think of this. The complaint of intermittent attacks of 'lumbago' or griping pains over one side, especially the right, should also aid in the diagnosis.

By recognising the cause of the illness, one may save future trouble. Routh (33) describes a case where there was a severe Acute Attack in a patient, who had complained of uneasiness in the Kidney region at different times, during a period of sixteen years.

Although many of the cases pass off without giving much trouble, many of them become chronic and are the source of much ill health and may later take on an acute exacerbation.

DIAGNOSIS/

D I A G N O S I S.

The Diagnosis can be made only on the isolation of the B. Coli from the urine and the careful elimination of other conditions such as stone or Tubercle, which may be the primary cause of the disease. Dudgeon (11) lays stress on the importance of making a cultural examination, as it is not possible to differentiate the B. Coli by staining, from B. Typhosus, B. Proteus and other Bacilli.

There are important points in the history and examination of a case that should make one look for the B. Coli. These we may briefly mention. In patients with bladder symptoms the diagnosis is made at an early stage, for in these cases a thorough examination of the Urine is made. Importance is laid on the fact that more than one examination should be made, if the first be negative. A "pregnancy Cystitis" or Pyuria in Pregnancy should direct one's attention to it, especially if the pus persists in spite of ordinary treatment.

In those cases where the bladder symptoms are not prominent, there are other points. The temperature rises suddenly, often with a rigor and the/

the temperature is irregular and swinging. This is important in women, especially those who are pregnant. There is sudden and Acute Abdominal pain, more especially on the right side. There is a wide area of hyperaesthesia in the Kidney region, sometimes most acute in the Appendix region. Marked tenderness in the back is usually found, especially in the Costo-Vertebral Angle. Acute abdominal distension is common. The Kidney will be felt to be enlarged. Vomiting is another symptom of importance. The Pulse rate was considered by Wallich (40) not to rise in proportion to the temperature, but Ward (40) found on a large series that this was of no significance. In the puerperium it should be remembered as a cause for fever and distressing symptoms, as the diagnosis from puerperal fever is important in relation to treatment.

It should be borne in mind that the Urinary system is one which is likely to bear the brunt of any disease in pregnancy. Accordingly the lesson is that a most careful and frequent examination of the Urine in Pregnancy should be made in every case and the bowels be carefully regulated. Its common occurrence in children especially with rigors should be remembered and it is useful to know that in many obscure/

obscure diseases, put down as neurasthenia etc., the B. Coli may be the chief cause.

in clu...

The Urine may draw attention to the condition. Pus in an acid Urine with Albuminuria is an important symptom, although pus or even cloudiness due to Bacilli is not always present. If there is any suspicion of this Infection, even a perfectly clear Urine should be examined culturally.

An important aid in diagnosis is Cystoscopic examination (27). Usually by this means the bladder is seen to be moderately inflamed and pressed upon by the pregnant uterus. If both Ureters be catheterized the specimen from one will show pus and urine, while that from the other will be normal except for a large number of granular renal epithelium cells. The mucous membrane of the healthy side bleeds more easily than that of the diseased.

DIFFERENTIAL/

DIFFERENTIAL DIAGNOSIS.

Where so many forms of the Infection are found, it is natural that the resemblance to a large number of different diseases should be a source of error in diagnosis. We may consider the chief of these and show wherein the danger of confusion lies.

I. OTHER AFFECTIONS OF THE URINARY TRACT.

This in many cases can only be settled by Bacteriological examination. Pus in an acid Urine is very suggestive of B. Coli. The symptoms of Cystitis are common to both, and Pyelitis and affection of the upper part of the tract are caused by other organisms, although less frequently. In the Chronic cases Tuberculosis may be diagnosed, but in many Tubercular affections of the Urinary tract, there is a secondary B. Coli infection. Prof. Hutchens maintains that many of the distressing symptoms in that condition are caused by the B. Coli and great relief is given, when the B. Coli has been successfully combated.

In some cases chronic B. Coli Infections prepare the way for the Tubercle Bacillus, which is an important factor in the Prognosis.

A common error in cases complicating pregnancy is to put it down as "Albuminuria of Pregnancy". Champetier de Ribes states that since his attention has been drawn to the subject, he has found that many cases of Albuminuria of Pregnancy are mild forms of Pyelo-nephritis.

Stone in the Pelvis and Ureter are affections, which have to be eliminated in the diagnosis. The spasms of pain closely resemble those accompanying the passage of a renal calculus. It is complicated by the fact that the presence of a stone may lower the vitality of the part and prepare the way for a Pyogenic factor more especially where the patient is pregnant.

II. MALARIA has been made as a diagnosis by more than one observer in malarial districts. Batty Shaw (35) records a number of cases, which were so diagnosed because of the sudden onset, the rigors and the intermittent temperature. The examination of the blood was however negative.

III. INFLUENZA: especially of the Gastro-Intestinal form may be diagnosed in the severe lesions, while the milder forms may be mistaken for a slight influenzal cold.

IV. PNEUMONIA/

IV. PNEUMONIA AND PLEURISY are very frequently diagnosed. The proximity of the two organs and the area of the pain naturally lead to this error. This is further corroborated by the cough. In Case II this was marked. In children this is frequently the diagnosis which is made, but John Thomson (37) and Kerley (21) have laid stress on the importance of rigors in diagnosis. Except in Pyelitis it is a rare symptom in children. The cough also has lead some to think of Tuberculosis.

V. CEREBRAL MISCHIEF has been suspected in children. The children are sometimes drowsy and delirious and their eyes often deviate. (Thomson) Briscoe (7) relates a case of a child of 9 months admitted to the Evelina Hospital. Three months before she had bronchitis and occasional discharge from the right ear. Three days before was the last occasion on which the discharge had been seen. On that day she had a fit. There was no sign of congenital syphilis. The child had been correctly fed and the nutrition was good. Several fits followed. There was a slight right sided internal squint, slight head retraction with marked irritability and general cutaneous hyperaesthesia. Kernig's sign was present and a questionable left internal squint. The knee jerk/

jerk was not obtained on the right side. By lumbar puncture 16 c.c. clear fluid without cells and sterile, were obtained. This relieved the cerebral symptoms. The urine was acid, contained large quantities of pus and B. Coli. Calmette's reaction was negative. The temperature ran from between 99° and 105° F. Pulse: 140 to 150. The child died on the eleventh day after admission. At the post mortem nothing abnormal was found and cultures from the spleen, heart blood, and kidney were sterile. The case was suggestive of an acute Toxaemia and the only pathological condition found was the presence of B. Coli in the urine.*

VI. ENTERIC FEVER may be suspected in some cases and the meteorism often suggests this condition.

VII. ACUTE ABDOMINAL INFLAMMATIONS are the most common and most likely to be diagnosed. The abdominal pain nausea, vomiting, constipation distension furred tongue, loss of appetite, temperature, quick pulse and blood examination make a picture closely resembling many acute Abdominal Attacks.

By /

* Thomson (37) has more than once seen Tuberculous Meningitis diagnosed as acute Pyelitis because of the presence of pyuria, which was really the indication of a secondary and terminal Cystitis.

By far the most common error in diagnosis is to take it for Appendicitis. This is made very easily when the Right side is affected and especially where there is great tenderness at McBurney's point. Brewer reports eight cases in one of his papers, in five of which Acute Appendicitis was diagnosed. Probably some cases, where an appendix abscess was suspected and at the operation a healthy appendix was discovered, are of this nature.

While a resident in Hospital I saw a case which comes under this heading. A woman aged 28 was admitted with acute abdominal pain, especially in the Appendix area. The temperature was 103° and the Pulse 100. The picture closely resembled one of an acute attack of Appendicitis and operation was decided upon. Just as she was being taken to the theatre, the report was made that the Urine contained a small quantity of pus. This was considered as an indication that the abscess was discharging through the Urinary tract. At the operation the appendix was found to be healthy but was removed. On further examination the peritoneum over the Kidney appeared oedematous. The Kidney was enlarged and its lower pole further down than normal.

After the operation the temperature remained high for a few days and then came down and although/

although there was pus in the Urine the patient improved and left hospital. A bacteriological examination was not made. Shortly afterwards she returned with a huge abscess in the right flank. This was opened and found to contain a large quantity of pus. A Urinary Fistula developed and did not close up. A further operation was advised, but the patient wished to postpone it and left hospital and her further history is not known to me. This was an example where a serious mistake was made by overlooking the significance of the Urinary examination in the first instance. Had we been on the look out for the condition and familiar with its features, the treatment would have been different from the commencement.

ACUTE INTESTINAL OBSTRUCTION is not by any means unlike this condition. The abdominal pain, vomiting, distension and sudden onset may mislead one in making the diagnosis. Considerable distension may complicate B. Coli Cystitis, but it is still more frequent and greater in extent in cases, where the infection has reached the higher portions of the Urinary tract.

Other abdominal infections closely resemble this disease e.g., Acute Cholecystitis may readily be/

be diagnosed where the Pyelitis is associated with jaundice. Fortunately this is not very common, except in cases of the septicaemic variety, when the infection is widely scattered.

Of course it is possible for some of these conditions to occur at the same time. Cases of Appendicitis have occurred along with B. Coli infection of the Urinary tract, While other infections may similarly mask the presence of the B. Coli infection.

Prognosis /

P R O G N O S I S.

This is a difficult question to discuss, and under it are propounded by different writers, views which are at the extreme poles. It is not fair to judge from one's own limited experience, while those thought worthy of publication are not real tests, as they are usually cases with some special features about them.

It is first necessary to decide whether the case is an uncomplicated one of B. Coli infection, or one where there is some other pathological condition present in the Urinary tract. That is in chronic cases, for acute infections are usually uncomplicated. In chronic cases it is necessary to eliminate Tuberculosis of the Urinary Tract, Renal Calculus, New Growths of the Kidney and Bladder, pyonephrosis, prostatic enlargement and stricture of the Urethra, all of which may be associated with B. Coli infection. The presence of the B. Coli in the urine does not imply that it is the sole cause of the patient's illness. The Proteus group more often produce a secondary Infection in cases of Calculus and Tuberculous Cystitis. Occasionally the Staphylococcus Aureus is a more important factor.

The Prognosis may be regarded (a) as to life. /

life. (b) as to duration.

(a.) As to Life. The consensus of opinion is that it is good. In a large number of cases if the diagnosis is made early and subjected to simple treatment, the disease is speedily cured. Morse (25) had only one death in 50 cases in children. Ward, (40) on the other hand, had 4 cases out of 13 in Pregnancy Pyelitis. Brewer (6) had a large number of deaths when he tried nephrotomy, but was successful in saving the lives of some patients when he did nephrectomy. In some cases in Pregnancy the prolonged disease and wasting has led to death after delivery or in a year or two from Phthisis, contracted when the system was weak. With regard to the foetus the prognosis is very bad. In nearly half the cases there is abortion in severe cases, and often the children are small and delicate even at full term.

(b.) As to duration. Relapses are common. They may appear after exposure to cold or over-exercise. They may come on suddenly and /

and may return after a considerable interval of convales^cence. It may recur in subsequent pregnancies, but this is by no means the rule. In fact under careful treatment it is possible for the next pregnancy to be quite normal.

In both children and adults the prognosis as to duration should be guarded. The majority of the cases are of short duration but an acute case may become chronic and last for weeks, months, or years. Chronic cases under all forms of treatment are slow in their course but fortunately do not cause great inconvenience.

In children a large number especially those of acute onset clear up easily, while others with less pronounced local symptoms drag on with intermissions and exacerbations, sometimes for months. Thomson states that if Alkalies be not given there may be extension of inflammation from the pelvis to the substance of the kidney with the production of multiple abscesses.

The cases of incontinence of Urine also vary considerably. The variations are due to either variations in the virulence of the organism or to variations in the resisting power of different individuals.

The prognosis depends on the treatment to

a great extent. Dudgeon (11) found in his own experience that the prognosis is satisfactory quite apart from surgical interference. Barnard, (1) on the other hand, considered it necessary in many cases where only one kidney was involved, to excise the kidney, a procedure which was followed by immediate cure.

MORBID ANATOMY.

We may now pass on to consider the interesting questions surrounding the cause of the Infection. With this in view, it is necessary to discuss the condition found in those cases where the kidney has been exposed during an operation, and the condition of those examined post mortem. This leaves a large number of cases whose pathological condition we have to infer, as only a small proportion come under either of the above heads.

In some cases there will be evidence of cystitis, but not in all. The condition of the bladder may now be seen in the Cystoscopic examination and has already been described. The ureter is usually thickened and there is often dilatation. Stoeckel (36) lays stress on the fact that there are /

are three places in the Ureter where normally there are slight constrictions, viz:- just below the pelvis of the kidney; at the level of the Pelvic brim ; and at the entrance to the bladder. It is above these three places that most commonly abnormal dilatations are found. The dilatation of the ureter is most common just above the brim of the pelvis and can often be felt per vaginam. Where the constriction is just below the Pelvis of the kidney the lining membrane of the Pelvis is inflamed and there is congestion of the kidney, causing enlargement of it, sometimes to double its normal size. Often at first the Renal Parenchyma is not invaded by the Infection, but there is intense congestion and dilatation of the subcapsular veins, occasionally subcapsular haemorrhages, cloudy swelling and small-celled infiltration.

At a later stage there is Abscess formation. The areas are numerous and of different sizes, most frequent near the capsule. In one case described by Barnard,(1) the foci of suppuration radiated from the medulla to the cortex. There may be wedge-shaped areas of suppuration. From a naked-eye examination, it is not possible to say whether these are due to emboli or to ascending Infection. Sundberg, (22) points out that when an embolus/

embolus is the cause, the area is interlobular and the apex terminates in the intermediate zone and between two pyramids, when the wedge is due to an ascending infection it is intralobular and the apex passes down into a pyramid. The central parts of the wedges are pale, necrotic and suppurating. The pus cells are in the stroma and within the tubules. In two of Dr. John Thomson's (38) cases, Professor Stuart Macdonald found the collecting tubules dilated and showing catarrhal change, lumen being filled with cells, mostly polymorpho-nuclear leucocytes. There was acute catarrh of the covering cells of the papilla. In one of the cases the calyces and apices of the pyramids were entirely denuded of their epithelial covering.

At parts there was desquamative change in the ureter, and dilatation, with cellular infiltration around, of the small vessels of the submucosa and muscular coat. Among the pus cells organisms resembling B. Coli were seen. There were no embolic plugs of bacteria to be demonstrated and both resembled cases of ascending infection.

The Perirenal tissues are markedly oedematous; this was very marked in the case I saw operated on for Appendicitis.

Where the infection of the upper portion
of /

of the tract is secondary, some existing disease such as calculus is found.

Usually only one kidney is severely affected, although the other one may show slight congestion.

BACTERIOLOGY.

Although the B. Coli is the most frequent organism in Genito-Urinary infections, it is not the only one. Of 56 Cases, Ward (40) says, in 44 the B. Coli was found, in 9 a Streptococcus, in 2 staphylococcus, and in only 1, the Gonococcus. Coli-form Bacilli and B. Proteus have also been found.

In some cases there is a mixed infection. As a rule streptococcal and Staphylococcal infections are more serious, as also are some of the mixed infections. In chronic cases the Tubercle Bacillus is frequently found, if carefully looked for. In these cases, the B. Coli is more easily detected and the presence of the Tubercle Bacillus is overlooked.

The B. Coli is a normal inhabitant of the Alimentary canal and has been described as having an action antagonistic to the putrefactive bacteria in the Intestine. Its pathogenicity varies under different circumstances. Dudgeon and Sargent (12) isolated three strains from the peritoneal exudate of /

of a case of ruptured typhoid ulcer and found a difference in culture and in pathogenicity to guinea pigs in the case of two of them.

In regard to both culture and its immunity reactions, it closely resembles *B. Typhosus*. As already mentioned it has the power of Acid formation and in ordinary media also the power of gas formation. Escherich, (14) has shown that in the Urine, if albuminoid bodies be present, it has the power of disintegrating these, setting free such products as Indol, sulphuretted Hydrogen and Methyl-amin. It is to the last of these, when present that the urine owes its "fishy" odour. It has not the power of splitting Urea and hence the freshly voided Urine does not have an Ammoniacal odour.

The *B. Coli* produces a Haemolysin and an Endotoxin, (13) on the latter of which its pathogenic action probably depends. Its vaccine is moderately toxic, causing severe local irritation and general febrile reaction, if the initial dose be large. Filtrates from broth cultures are practically devoid of toxicity. The diseases due to *B. Coli* are almost invariably local inflammations. Septicaemic conditions are rare except as terminal phenomena. In this respect it differs greatly from the *B. Typhosus*, in which the diseases are usually septicaemic and the localized infections only occur as sequelae.

The /

The B. Coli may affect almost any part of the body, causing besides the lesions in the Alimentary and Urinary systems, Broncho Pneumonia, Otitis Media, Endometritis, Metritis, and a number of other diseases.

Dudgeon, (11) has found that in most patients suffering from B. Coli Infection of the Urinary tract, acute or chronic, there is a low opsonic and phagocytic index. Treatment by Vaccines causes a gradual rise; reaching 5, 6, 7, or 8. Treatment by Anti-Colic Sera often causes a marked rise in a few days after the first injection to over 3. The high index is not constant, but may occur after injecting simply normal horse serum.

In neither normal nor pathological Urine is there any evidence of any substance which increases or inhibits phagocytosis. Very few organisms are seen intracellularly in the pus; Dudgeon considers the results as not sufficiently reliable for diagnosis by the opsonic and phagocytic index.

The Agglutination Reaction of the patients serum he found, to be of little or no value in the diagnosis in most instances. In only a small proportion of the cases, was there sufficient Agglutinin present in the serum to produce clumping of the /

the bacilli in dilution of 1 in 20. Clumping with a dilution of 1 in 50 was found to be exceptionally rare.

AETIOLOGY.

Age. It may occur at any time of life; In infants it is most common during the first two years. In Pregnant Women, Ward (40) found it to be most frequent between the ages of 23 and 28.

Sex. It is much more common, as testified by most observers, in women. The importance of Pregnancy as a factor accounts partly for this, but even apart from this, it is more common in women. In children it is more common in little girls.

Pregnancy is perhaps the chief predisposing cause. The fifth month is the period, at which most cases occur. A chronic infection may become acute during pregnancy as in Routh's (33) case, where there had been symptoms for 16 years.

Some previous illnesses are noted as antecedents to the B. Coli Infection. Among those recorded are Chills and Influenza, Gastro-Enteritis, Food-poisoning, Scurvy in Children, and Scarletina, Constipation is very common, as also is Retention of Urine.

The /

The Kidney Affected is much more commonly the Right. In 65 cases out of 70, collected by Leguen, the right kidney was involved. In cases of Pregnancy, the explanation given is that of Cumston, (10) who considers it due to pressure by the Uterus. The Uterus develops much more to the right, inclines to the right, and undergoes a rotation on its vertical axis in the direction of its greatest development. It thus frees the organs on the left and exerts a greater compression on those on the right. At any rate the Ureteral obstruction begins at the level of the pelvic brim. On the other hand the condition is found from the first month, when the Uterus does not cause pressure on surrounding organs. Also one would expect to find it very commonly in fibroids and Pelvic tumours and in deformed Pelves, but this has not been noticed by any observers. In men and non-pregnant women ⁽³¹⁾ Rolleston suggests that the right kidney is more liable to be injured or to be floating and so is in a condition producing diminished resistance.

Stenosis of the Ureter, has been frequently noticed, most commonly at the pelvic brim. This might be caused by the pressure already mentioned. Distortion of the bladder is another factor, which has /

has been recorded by Pilcher. (27) In one of his cases in catheterizing the Ureter, the catheter had to be pressed downwards and backwards to engage the first portion of the Ureter.

Reed, (29) points out a serious objection to the view that the stenosis is caused by pressure of the pregnant uterus. He shows that any pressure sufficient to cause dilatation and retention in the Ureter above, would jeopardise the vitality of the Ureter with its delicate vascular anastomosis.

Mode of Infection. This is one of the most interesting aspects of the subject and the one which has raised the most controversy. There are three routes of infection, which have been advocated by different writers.

- (1.) Ascending.
- (2.) Descending.
- (3.) Trans-Parietal.

It is probable that Infection occurs by all three ways and it is not easy to decide by which most commonly.

I. Ascending Infection. Occurs in females, and especially in childhood. The explanation given is the shortness of the female urethra and its liability to be infected by discharge from the /

the anus and by thread worms. In adults there is frequently the evidence of ascending infection in the onset with symptoms of cystitis.

The most common pathway of ascent is

(a.) The Ureter. Bond (2) has shown that it is not necessary for the lower part of a mucous tract to be affected by an ascending inflammation. He further showed that solid particles can be carried up ducts in the reverse direction of the normal current. He demonstrated this by the use of sterilised indigo granules, which, applied to the lips of the Uterus, were found a day or two later in a pyosalpinx. Indigo placed in the rectum was found in a caecotomy wound three days later, although the bowels had been opened in the interval.

Bond has shown that these ascending currents are produced more favourably when there is any interference, either continuous or intermittent with the normal flow along the channel. Such an interference is present in pregnancy and also in other cases, where mobility or low position of the Kidney leads to kinking of the ureter. Also obstruction by a calculus or to the outflow from the bladder would have this effect.

Barnard, /

Barnard (1) contends that there are three great means of protecting the Kidneys from bacterial invasion from below: (1.) small lumen of the urinary passages. (2.) The complete emptying of cavities and tubes at frequent intervals. (3.) An intermittent flushing from above by a sterile fluid.

All these means are circumvented by an obstruction which dilates the urinary passages and cavities.

He further considers that the B. Coli probably travels along the mucous membrane, as the Gonococcus does and not along the urinary passages. In one of Wright's (42) cases the inflammation in each kidney subsided from time to time only to spring into activity again, seeming to indicate that re-infection took place from below.

Further considerations are: that in the majority of cases the lesion is unilateral and no other organs were affected: Again Nephrectomy is followed in Unilateral Cases by immediate cessation of all symptoms of septic poisoning. In Sundberg's (22) report, mentioned above, the wedge-shaped abscesses ended in the pyramids and were intra-lobular supporting the view of ascending infection.

(b.) The /

(b) The Lymphatics. (1.)

Another possible pathway is by the Lymphatics but evidence to prove or disprove this is wanting. Tubercle may first appear in the epididymis and then infect the Vesiculae and finally produce deposits in the cortex of one kidney, even when the mucous membrane of the Urinary tract appears normal. Other organisms possibly pass in a similar way from the lower parts and pass to the cortex of the Kidney.

(c.) The Blood Vessels. (3.)

The Anastomosing Arteries and Veins, which connect the bladder with the Kidney is another pathway. The infection may even be carried indirectly to the Kidney in the form of a true haematogenous infection. There is not much evidence of such infection, but Box (3) quotes experiments in which, after excision or ligature of one Ureter the corresponding Kidney has become converted into a pyonephrosis in consequence of artificial infection of the bladder.

II. Descending Infection.

Descending Infection or Haematogenous in contradistinction to the Urogenous or Ascending,
was /

was early advocated by French writers. Such infections are seen in some cases of Tuberculosis of the Kidney. Many infectious diseases are not infrequently complicated by a pyelitis, and by a B. Coli Bacilluria. In Typhoid fever the B. Typhosus is found usually when the temperature is normal and the organisms are disappearing from the blood.

The Bacilli are able to pass through the wall of the alimentary canal, but probably only where there is a small lesion. Thus it may pass through the mucous membrane after Gastro-Enteritis, Diarrhoea or Constipation or find an entrance into the blood through cracks about the anus.

From Sherrington's (34) experiments it is generally recognised that organisms can pass through the kidney tissue, only when there is some damage. This may be produced by their toxins, by minute emboli, calculus, new growth, etc. It is difficult to understand how in a septicaemic condition only one kidney is affected, for in systemic pyaemia, such as in a case of Ulcerative endocarditis both kidneys and as a rule other organs, the spleen, the liver, or the brain, are affected, and there is associated with it the general symptoms of pyaemia. Brewer (6) explains the unilateral lesion by assuming that on that side there has been some injury to /

to the kidney, produced by trauma, by the presence of a foreign body in the pelvis or by an acute obstruction of the Ureter. He supports his view by experiments he undertook on different animals, chiefly rabbits; one kidney was injured either by an external blow, by bruising with fingers through a wound, by the injection of bismuth into the Pelvis of the Kidney or by ligation of the ureter; cultures of different organisms were injected afterwards into an ear vein. In eleven out of sixteen experiments, lesions were produced practically identical with those observed in his clinical cases.

Clinically, Descending Infection must be admitted, the evidence of which appears in cases like those of Professor Hutchen's, where treatment directed towards an infection of the bladder and kidney pelvis brought no relief, but yielded readily when the alimentary canal was attended to.

III. Trans-Parietal Infection or the passage of micro-organisms from the colon to the kidney, has been suggested by Mirabeau. (24) There is reason to believe that the B. Coli may pass from the Colon to the Urinary bladder and it is not unlikely that in a similar way it may pass to the adjacent Pelvis of the Kidney. The mucous membrane of /

of the colon must be damaged to allow the organisms to pass freely through the lymphatics and pericolic tissues. The proximity of the Ascending Colon and the frequency of lesions in the appendix may account to some extent for the more common occurrence on the right side.

For purposes of treatment it is important to consider in each case the probable mode of Infection. It is almost certain that Infection may take place by all the methods mentioned. Much has been written by advocates of one or other theory, but it is at present merely guess work, computing which course of Infection is the most frequent.

Treatment /

T R E A T M E N T.

I. GENERAL.

Under this head come the practical details of management of a Case which is particularly important in this disease, because often in the slighter cases there is a tendency to spontaneous cure and these only require simple methods of treatment. Some attention has been drawn to the question of posture. The horizontal position alone is sufficient for the cure in some cases occurring during pregnancy, probably by altering the position of Uterus and Ureter. Sippel advocates the lateral decubitus. Ward (40) quotes the case of a woman with a persistent fistula after nephrotomy, in whom the fistula was ultimately induced to heal by lying on the opposite side.

Others have recommended in cases complicating pregnancy for the patient to assume frequently the knee-chest posture in order to throw the uterus away from the ureter and relieve the pressure in this way. Pilcher (27) holds that the pressure of the bladder is more often the cause of obstruction, in which case this position would increase the pressure. He often observed during catheterization of the /

the ureter that droppings came very slowly, when the patient was recumbent. But if the patient assumed the sitting posture, the droppings increased fifteen or twenty times that observed before. He concludes that there is more to be gained from a position favouring drainage of the renal pelvis, in which the kidney was on a higher level than the bladder. The results treated from this point of view have been satisfactory.

If there be a possibility of an ascending infection the importance of frequent bathing and the avoidance of urethral contamination from the anus should be borne in mind as a preventative method. All cases of Vulvitis should be promptly attended to. In children with incontinence careful examination of the urine and stools should be made for the presence of thread worms.

A strict milk diet is ordered by most physicians. Ziegelmann states that it is indicated because it diminishes the virulence of the organisms in the intestine. (40). It is easily digested where there is no natural disinclination to milk. If taken in large quantities the constituents of milk have a distinct diuretic effect and the flow of urine is often greatly increased. The risk of producing hydraemic plethora should be borne in mind, especially /

especially where the kidney substance is severely affected. Where there is not this contraindication, plenty fluid should be given, especially alkaline waters or pure water itself.

In the milder cases a less strict diet may be given and in prolonged cases it is difficult to maintain the body-weight for long in an adult, simply on milk. The discomfort produced by frequent micturition due to the acid reaction of the Urine should be combated by ordering a diet rich in vegetable matter, so as to render the Urine less acid. (5)

Local treatment, such as poultices and opium or belladonna fomentations are to be remembered, as the relief from pain often allows sleep.

II MEDICINAL.

Where there is a tendency towards spontaneous cure or where the acute stage runs a definite course, it is difficult and misleading to ascribe special qualities to different drugs. We find then considerable variations in the opinions expressed on different lines of treatment. The majority of those who have written on the subject have had only a limited number of cases under their personal care and /

and the experience of particular drugs used in these cases is not as a rule sufficient to allow of generalisations in a disease, where the pathological conditions are known to be so widely different. Nevertheless there are a number of drugs which are worthy of trial. These we will consider seriatim.

APERIENTS.

As might be expected this is one of the most important lines of treatment. Constipation or some Intestinal lesion is so generally found that attention to the bowels is one of the first indications. The purgative used is not of great importance. Phosphate of Soda has been recommended by R. Hutchison. (37) because in addition to its purgative action, it tends to keep the Urine Alkaline. Calomel should be given occasionally. In one of our cases the constipation was extremely obstinate and recourse had to be made to enemata.

ALKALIS have been advocated specially by Holt (19) and Thomson (37). The latter speaking from experience in twenty-five cases in children says "the improvement under citrate of potash, if it was given /

given in sufficient doses, has been so steady and satisfactory that nothing else has been called for," but if the kidneys have become seriously affected neither it nor anything else seems to do any good. He believes in large doses of Potassium Citrate. The smallest amount he has found to be effectual is 24 grs. in the day, but as a rule he begins in infants with 48-60 grs. per day, increasing to 120, 150, or even 180, if the urine remains acid. The urine usually becomes alkaline in four days, but it may take as long as seven days. If the drug has produced profuse diarrhoea, its effect on the urinary reaction is weakened. He claims that if treated thus, the temperature falls and the other symptoms improve more rapidly than with other drugs, and the course is less protracted. The risk of relapse or extension of the disease to the kidney is not so great as with other methods of treatment. Even when Alkalis are pushed there is a tendency for the urine to become acid again in three to seven days with a rise of temperature and return of the symptoms, but rarely in those cases where very large doses have been given. In cases of mixed infection the use of Potassium Citrate has done no good, and seems even to have been harmful.

Box (3) combines with Alkalis sedatives of the /

the Belladonna group in incontinence of urine.

It is difficult to understand what effect the making of the Urine alkaline can have, for the Colon Bacillus grows more luxuriantly in Alkaline or Neutral than in Acid Media. When one remembers that in some cases Urotropin, which makes the urine acid, has also been beneficial, it makes one doubt as to whether the reaction of the Urine is of much consequence and whether the flushing down of the kidney and ureter is not the more important action of the drug.

Urinary Antiseptics have been advocated by a large number of writers. Hexamethylenetetramine, or Urotropine has been recommended strongly by Ward (40) for Pyelitis in Pregnancy. He advises doses of five to ten grains, preferably the smaller dose, three times a day in half a pint of hot water. He says that unless the case is a severe one or there are complications, which are beyond medical treatment, the temperature will fall within three days of the first administration. If there be vomiting, Helmitol, its methylene Citrate, may be substituted in the same doses. Hetraline, its Benzoyl derivative, has also been tried. Methylene Blue, (Marteville,) Aspirin, (Ruppener), Benzoate of Ammonium, Boric Acid, Salol and Salicylate of Sodium have all /

all been tried. Salol is useful as an Intestinal Antiseptic as well as a Urinary. Ritchie, (30) has noticed benefit in a child by the addition of Salicylate of Sodium to Potassium Citrate.

Urotropin and the other drugs of the formaline type have been used with great benefit in affections due to the B. Typhosus. Many observers have not found it as useful in B. Coli diseases. Its action is mainly that of an Antiseptic, but it also causes Diuresis. It is probably to this latter property that its usefulness is due. It makes the Urine acid and outside the body has the property of dissolving Uric acid. Probably neither of these properties is of value in this disease.

III Specific.

The same remark applies to this method of treatment as to drugs: that it is often difficult to tell what part in the recovery is due to the Serum or Vaccine. The opinions of different writers vary so much that it is possible that much of the virtue lies in the preparation of the Serum or Vaccine. Stock preparations are particularly useless in this condition and are condemned as dangerous by Hutchens. The preparation must be made from the patient's own culture.

(1.) Sera. /

(1.) Sera.

Emery (13) dismisses these in a line, as being quite useless. Dudgeon (11) on the other hand, has had most excellent results in acute cases. In 12 cases of acute infection treated by means of sera, on five occasions the effect was rapid and permanent and there was no return of the symptoms. In 4 cases the benefit was considerable, in two only very slight, while in the other severe joint pains resulted. To obviate these Calcium lactate should be given in doses of 20 grains , three times a day.

In subacute cases a serum does good also, but not to the extent found in acute cases. In Chronic Infections it is rarely of any value. Dudgeon proposes that 25 Cubic Centimetres of the Serum should be injected every day for three days.

If no effect is produced this method should be abandoned, as it is not likely to produce any benefit, if injected a few days later, while undesirable complications due to the horse serum may result.

Butler (8) also records a case where

a /

a B. Coli Serum proved promptly efficacious, but most others have not found it of use.

Vaccines.

Emery (13) considers this the only specific treatment of any avail. The Vaccine should be prepared from the patient's own culture found in the urine, those isolated from the stools being in general less virulent than those derived from the diseased tissues.

In some cases with high fever, Emery has found the Vaccine to act more like an Antitoxin. He instances a severe case of Cystitis under Mr. Burghard, where within ten days, the patient's general condition had quite improved and the pyuria greatly diminished. It had not disappeared entirely, however, when he was discharged. The general experience is that it causes great improvement, but complete cures are unusual. The initial dose should be 10 to 40 millions. If the injections are not made with opsonic control, they should be given every eight to twelve days, doubling the dose each /

each time. It will rarely be found advisable to exceed 250 millions.

Dudgeon (11) has also treated a considerable number of chronic cases with a Vaccine and found likewise that a complete cure was not common. The patients often felt better, but the condition of the urine remains unsatisfactory.

Professor Hutchens has used a Vaccine on a number of patients with Coli Bacilluria and obscure symptoms. His results have been excellent, but have not yet been published and it is not possible to say whether the cure has been permanent.

A number of cases of treatment by Vaccines have been recorded with varying results. In one of the cases recorded here a Vaccine prepared from the patient's own culture was tried without any result, except for a short remission of the symptoms, commencing half an hour after the injection; a remission which was probably accidental.

If the treatment be prolonged, a fresh Vaccine should be prepared from time to time, since the organism may change its type to accommodate itself to the immune substances produced.

IV. Operative /

IV O P E R A T I V E.

I. A method of treatment which has been advocated recently and which has had excellent results is douching the Kidney Pelvis with an antiseptic through the Ureteral Catheter. Kelly and Caper^s recommend this procedure and it is mentioned in Thomson and Miles: (38.) Manual of Surgery. Stoeckel (36) and most recently Pilcher (27) have claimed splendid results from this method.

Stoeckel holds that it is neither dangerous nor complicated. He describes his method thus;

"I force the catheter gradually as far as the renal pelvis and receive the flowing urine into a glass: then I connect the pavilion of the catheter by means of a gum elastic tube, with a very easily worked 50 c. cm. capacity syringe, whose contents I pass up very gradually and with equable pressure into the pelvis of the kidney. The fluid returns to the bladder alongside the catheter, if the catheter is thin and the ureter lumen not quite filled up. After removing the syringe, a portion of the infected fluid runs out of the catheter into a glass and is again tested: a 1% solution of silver nitrate is the fluid I most commonly use. "

Pilcher /

Pilcher considers it safe, if the symptoms are not too severe to wait for eight or ten days before catheterizing the Ureter. If at the end of that time the temperature still was high and there was pain and pyuria, he would pass the catheter to the pelvis of the affected kidney, and after drawing it thoroughly, instil one drachm of 25% Argyrol solution. In a week's time the number of pus cells will be greatly diminished.

Where there is great retention in the pelvis of the kidney, it is indicated to leave the Ureteral catheter in place after washing the pelvis of the kidney for four or five hours or longer, repeatedly washing out the pelvis of the Kidney.

II. Induction of Labour.

In cases complicating Pregnancy one has to consider whether it is in the interests of the mother to allow the Pregnancy to go on. Fortunately the acute symptoms do not last long in the majority of cases and with treatment on the lines already mentioned the Pregnancy will go on in many cases to full time. In some cases however there is no benefit from any form of treatment available, and the patient is losing ground. In these cases there is risk /

risk of serious damage being done to the kidneys. The induction of labour is followed by a rapid recovery.

In many cases the patient will abort if left alone and the symptoms continue unchecked. This was seen in the case of Mrs. B. and the result of Abortion in that case with immediate relief shows that Induction of Labour is the proper line of treatment where the patient is losing ground. Another indication, which makes it advisable is where there are signs that the condition is bilateral.

III. Nephrotomy and Nephrectomy.

Operations on the kidney itself is the last resource, which fortunately has not often to be made use of. Where the condition is secondary to a calculus, surgical treatment will be required. Also it is indicated if there be a Pyonephrosis, as sometimes happens in chronic cases. But there are some cases, where the suppuration spreads into the kidney substance and the patient suffers from a severe toxæmia. In these cases no medical treatment is of any avail and operative interference has to be considered. One has to decide beforehand whether the Infection is Unilateral. In one of Brewer's (6) cases a kidney with septic Infarcts was /

was removed. The septic symptoms improved at once, but the patient became Anuric and died in fourteen days. The other kidney was found to be completely destroyed by an old tuberculous infection.

There are two methods available, (a) Nephrotomy, with drainage and perhaps excision of portion of the kidney and a rapid Nephrectomy. In the former case the convalescence is prolonged, but in the end the patient is in a better position, having two kidneys instead of one. Brewer performed Nephrotomy in five cases and four of them died. He seems to have been very unfortunate in these cases.

French (15) records a case where at the operation the kidney was studded over with small abscesses and the patient's condition was too critical to excise the kidney. The manipulations seem to have relieved some pressure on the Ureter for the patient made a good recovery.

(b) Nephrectomy can only be attempted where the other kidney is functioning well. The advantages are the rapid cure which follows in Unilateral conditions. It is fraught however with risks, as it means certain death if the other kidney at a later period becomes seriously affected. It should therefore be reserved for Unilateral cases with

with symptoms of marked toxaemia, which withstand all medical treatment and are not relieved by Nephrotomy.

SUMMARY AND CONCLUSIONS.

Attention was first drawn to the subject in 1892. Interest has been increasing recently and it appears to be very common in occurrence, if properly understood and looked for.

EXAMPLES.

CASE I. B. Coli Infection in a Primip. V month. There was a previous history of Cystitis a year before. Attack began with Cystitis. Right side then affected. When it was recovering, Left side attacked. Typical case of ascending infection. Marked Meteorism. No Casts. Treatment by Alkalis satisfactory. Pregnancy not interrupted. Now in good health, a year after.

CASE II. Primip. IV. month. No preliminary Cystitis. Marked constipation. Renal parenchyma of Right Side involved. Casts in Urine. Patient very ill. Alkalies had no effect. Vaccine of no avail. Spontaneous abortion produced rapid and marvellous result. Relapse a week after on stopping the alkalies. Now well, a year afterwards.

CASE /

CASE III. Nullip. Preliminary Cystitis and extreme constipation and moveable kidney on Right side. Right side attacked. Treatment by Urotropin, Aperients and Intestinal Antiseptics gave good result. Now in good health.

CASE IV. B. Coli Cystitis in old lady of 91, who had Dislocation-Fracture of Spine with longstanding Cystitis and Ammoniacal Urine. An acute Cystitis supervened and Urine became Acid and gave pure B. Coli Culture. Urotropin given. Acute stage passed off and patient is in fair health, although B. Coli still present in pure culture.

CASE V. Mild attack in IV. month of Pregnancy. Acute stage slight. Preliminary Cystitis and later symptoms in Right Flank. Passed off without patient lying up or having any treatment but aperients. B. Coli present in pure culture.

CLASSIFICATION.

Infection is considered in this paper
from /

from the regional aspect.

(1.) Bacilluria. Cases of B. Coli in Urine occur without producing any symptom referable to the Urinary tract. Cases are quoted where this has occurred. Frequently in Incontinence of Urine in children there is no other symptom. Recently Coli Bacilluria has been found to be associated with symptoms of a neurasthenic type, also with Postural albuminuria. In some cases, B. Coli discovered accidentally in healthy persons.

(2.) Urethritis. Acute case is quoted, a very rare condition. In chronic Urethritis, B. Coli has been found without Gonococcus. Probably some cases of "Gouty Urethritis" are of this nature.

(3) Cystitis. B. Coli is found in about half the cases of Cystitis, usually in mixed Infections. B. Coli Cystitis is common in children. Character of Urine is similar to that of Infection of the Upper portion of Tract. Diagnosis is made by careful examination of symptoms and absence of pain in flanks. Microscopical examination is of no use in differentiating. Note on Pain in Bladder affections is given.

(4.) Infection of Upper portion of Tract.
Ureteritis /

Ureteritis, Pyelitis, Pyelo-Nephritis, and Suppurative Nephritis.

(a.) In Children. There is a sudden onset with rigors, rare in other diseases of children. Temperature up to 103 or 104° with marked daily fluctuations. Restlessness and misery are characteristic. It is most common under 2 years, especially in girls. In boys, occurs after circumcision. Sometimes there is suppression of Urine at first: later increase of quantity. If protracted child becomes emaciated, has pronounced sweatings and enlarged spleen. Usually there is a history of previous Gastro-Intestinal disturbance, fissure or excoriation of anus, worms, perineal injury, chill, or scurvy.

(b.) In Adults. It is most common in Women, especially in Pregnancy, Right side is most commonly affected. Age of pregnant woman: 25, the most common, and at the 5th month of Pregnancy, although possible at any period.

Onset is acute. Rigor often. Sometimes there is a preliminary Cystitis. Temperature usually swinging, but Pulse and Temperature /

Temperature are not characteristic. Bowels very constipated. Tongue thickly furred. Great thirst. Loss of appetite. Severe headache. Depression, loss of memory and mental perturbation. Meteorisms are frequent. Pain is wide-spread over flank, usually right side. Superficial and Deep tenderness. Often there is marked rigidity. Spasms pass from back down to groin. McBurney's point is often very sensitive to pressure, also Costo-Vertebral angle of affected side; Note on Pain is given, considering it as a Viscero-Sensory Reflex and also on Rigidity as a Viscero-Motor Reflex. Usually condition is Unilateral. Kidney is enlarged and palpable.

Urine. Dysuria and frequency of micturition often is the first thing noticed. B. Coli may be present in quite clear Urine or in Cloudy urine without pus, or with flocculent deposit of pus. It is invariably Acid when freshly voided, with a "Fishy" odour, due to formation of Methyamin, if Albuminous bodies are disintegrated; never Ammoniacal. Where retained, it becomes Alkaline, as in specimens drawn /

drawn off from Kidney Pelvis, where there has been some retention. Explanation propounded is that although B. Coli forms Acid in Peptone Media or where there is no sugar the Acid formation is only for a short time and the Media becomes alkaline. This is what happens in the retained Urine of the Kidney, Pelvis, Acid Urine makes the other organisms disappear from the Urine.

Albumin is almost always present, often in small quantities; usually a Nucleo-Proteid also. No sugar or Bile. Blood occasionally, but not as a rule.

Microscopically Leucocytes and Bacilli, extra-cellular and gram-Negative, showing beading and clumping. Epithelial cells can not be considered of importance in diagnosing the site of Infection. Casts are found where Kidney substance affected. Bacillus Coli can not be identified, in films, from many other organisms, such as B. Protens, Typhoid, etc. Cultural reactions are necessary.

Leucocytosis present and secondary Anaemia. Polymorphs especially increased. When illness severe, heart dilated. Often absence of vesicular breathing at adjacent base /

base of lung. Gastro-Intestinal disturbance and also mental is found. Uraemic symptoms are rare.

VARIETIES. are, (1) Mild. (2) Severe. (3) Chronic. Mild attacks are often mistaken for "lumbago". May pass off or become Chronic. In Chronic cases there is malaise, muscular pains, irregular temperature, headaches and fatigued appearance. Bladder symptoms are slight or absent. Neurasthenia or Hysterical symptoms sometimes manifested.

Acute stage passes off usually in less than a fortnight, although pus found weeks or months afterwards. Chronic cases are very difficult to cure. In these cases a careful examination for Tubercle Bacilli should be made

DIAGNOSIS is by cultural examination of Urine and elimination of the conditions such as Tubercle or Stone and careful attention to history and symptoms. Cystoscopic Examination and Catheterization of Ureters help.. Bladder is seen to be moderately inflamed. Urine from one Catheter contains pus, the other only granular epithelial cells. Mucous membrane/

membrane of healthy Ureter bleeds more easily than that of the diseased.

DIFFERENTIAL DIAGNOSIS is from Infections of the Urinary tract, albuminuria of Pregnancy, Malaria, Influenza. Pneumonia and Pleurisy. In children cerebral mischief. Tuberculous Meningitis is sometimes diagnosed as Pyelitis and vice versa. The children are frequently drowsy and delirious and their eyes deviate. Enteric Fever has also been diagnosed. Most common are Acute Abdominal conditions. Appendicitis most frequent of all.

PROGNOSIS. Depends largely on what complications are present. If simple this may be considered with regard to.

- (a) Life. which is good. Only in a few cases is the Infection Hyperacute. Even in these Nephrectomy has been followed with prompt cure. In pregnancy patient may abort and so gain relief as in Case II.
- (b) As to Duration. This is very variable. Prognosis should be guarded. Second Pregnancies may be quite free from any attack. In the majority of cases the attack is short. In chronic cases all forms of treatment have little success.

MORBID ANATOMY. Ureter is usually dilated. This is discussed fully and description of the excised kidneys in operations and Post Mortems given. The majority of cases recorded suggest that they were due to ascending Infection.

BACTERIOLOGY. B. Coli most common organism found in Pyelitis and renal infections. Different strains are found in the Alimentary canal and it differs widely in its pathogenicity under different circumstances. It resembles B. Typhosus closely. The chief distinction pathologically is that with B. Coli the diseases are local inflammations while with B. Typhosus they are septicaemic.

The opsonic and Phagocytic index and the Agglutination reaction are too unreliable to be of use in diagnosis. Our knowledge of this subject is briefly reviewed.

AETIOLOGY. Pregnancy is important and frequently there are antecedent illnesses. The Dilatation of one of the ureters is frequently noticed.

Mode of Infection is the subject of much controversy.

(1.) Ascending Infection.

(a.) By Ureter. Bond has shown that particles /

particles can pass up by ascending currents along ducts in a contrary direction to the normal current, especially if the normal flow is continuously or intermittently checked. This happens in Pregnancy, kinking of ureter, presence of stone, obstruction to outflow from bladder. *B. Coli* probably passes like *Gonococcus* along the mucous membrane and not the lumen of the ureter.

- (b) By Lymphatics. Just as the Tubercle Bacillus passes upwards without any lesion in the mucous membrane being produced.
- (c) By Blood Vessels. After excision of one Ureter, artificial infection of bladder has produced Pyonephrosis by Haematogenous infection. It may also occur by the anastomosing vessels of the Ureter.

Arguments in favour of Ascending Affection are in the history, where sometimes the course of the disease can be traced upwards; the unilateral condition; beneficial results of Nephrectomy; the more frequent occurrence in females; the condition found in many Post Mortem examinations.

II. Descending Infection.

Bacilli can pass through mucous membrane
of /

of alimentary canal if there be some small lesion. Organisms are excreted by Kidney if there be a lesion. In unilateral conditions the explanation has been put forward that injury or some depressed condition of one kidney may favour the Infection attacking that side.

In many cases there is no cystitis, although that does not exclude the possibility of an ascending Infection. The Condition of Bacilluria following on Intestinal diseases is suggestive of a B. Coli Septicaemia.

(3.) Trans-parietal.

Due to proximity of Ascending Colon to Right Kidney. The presence of the Appendix may account to some extent, for the greater frequency on the right side.

Probably infection occurs by all three routes.

TREATMENT /

T R E A T M E N T.

GENERAL.

Postural: lateral decubitus is recommended. also position favouring drainage from pelvis gives good results, cleansing of External Genitals and in children examination for thread worms is important. Milk diet is advisable and large quantities of fluid. If less severe and course prolonged a more liberal diet may be given, rich in vegetable matter. Local applications as poultices etc., are important.

MEDICINAL.

Aperients most important. Calomel or other drug. Phosphate of Soda tends to keep urine Alkaline and has been used for this purpose. Enemata may be required in some cases.

ALKALIES in large doses are probably the most useful and in two or our cases were satisfactory. It seems uncertain whether the reaction of the urine can have any effect on the growth of the B. Coli. The flushing of the Kidney is at any rate beneficial.

URINARY ANTISEPTICS: Urotropine used largely.

Benefit is great with some, but doubted by many authorities. ²ⁿ Giving in half a pint of hot water, three/

three times a day. May be given along with alkalies. It makes the Urine Acid. Probably this does not affect the action. Helmitol, Hetraline. Methylene Blue. Aspirin. Benzoate of Ammonium. Boric Acid. Salol and Salicylate of Sodium have all been given.

SPECIFIC.

Preparations should be made from the patient's own urinary culture. A review of the results is given.

(1) Sera. Emery found sera to be useless. Dudgeon has used them with success in Acute Cases. Dose. 25 c.c. every day for three days. If it has no effect, its use should be abandoned.

(2) Vaccines. Emery found that in some acute cases it acted almost like an antitoxine.

In Chronic Cases the general opinion is that it improves the patient's condition, but rarely produces a complete cure of the Urinary symptoms. Initial dose 10 to 40 millions. Repeat the injection every eight to twelve days, doubling the dose, but not raising it above 250 millions. If used for a long period a fresh vaccine should be prepared from time to time.

OPERATIVE/

OPERATIVE.

(1) Douching Kidney Pelvis. and washing out with 1% Solution of Silver Nitrate or 25% Argpyrol Solution by a Ureteral Catheter has been advocated and gives excellent results. The method of carrying it out is described. If there is great retention, the Ureteral Catheter may be left in place for five hours or longer, with repeated washing out of the pelvis of the kidney.

(2) INDUCTION OF LABOUR. is not often required. But if the patient is losing ground with the other methods of treatment available, there is fear of serious damage to the kidney. If there is evidence of affection of both kidneys then Abortion should be produced.

(3) NEPHROTOMY may be required where there is a Calculus or a Pyonephrosis as in some chronic cases. But in some cases of profound toxæmia, Nephrotomy and drainage with partial excision of diseased portion should be tried. The convalescence is prolonged but the patient is in a better position afterwards. If the case is bilateral excision of kidney is not to be thought of.

(4) NEPHRECTOMY should only be performed when the other Kidney is functioning well. It should be reserved/

reserved for Unilateral Hyperacute cases and may produce a rapid cure.

Finally we may say that many cases will get better with little or no treatment. In the majority, medicinal treatment will be sufficient. Diluent drinks, Milk diet and Alkalies in large doses should be tried at first with rest in bed. Urotropin in addition or without alkalies may be tried. If the condition does not improve catheterizing the ureters should be tried, if available. Induction of Labour may be advised without fear if the patient is losing ground and the other operative measures should be reserved for cases of an acute toxic character or where the Kidney substance is seriously involved.

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